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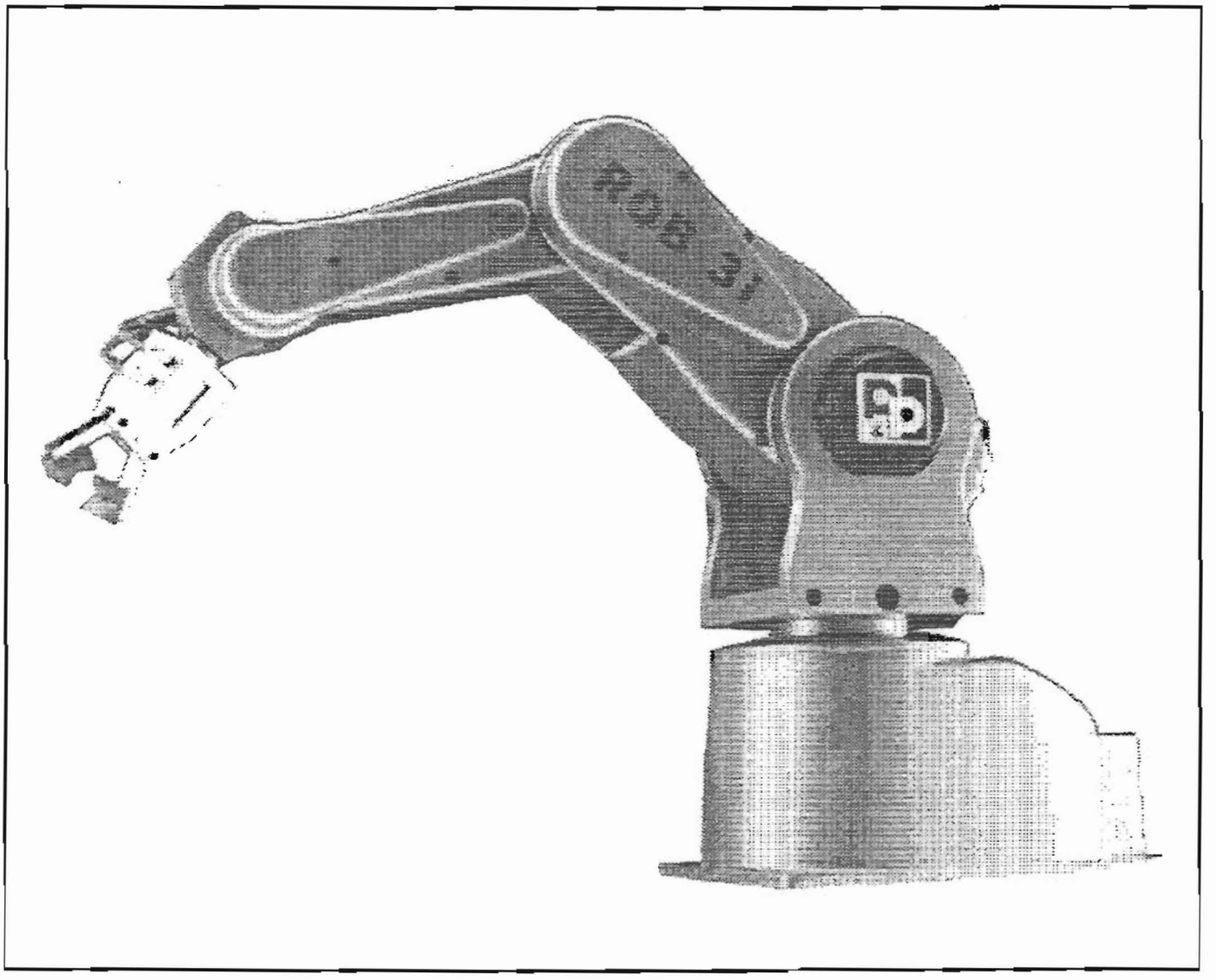
TEACHBOX

User's manual for ROB 3i



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1. Introduction

The ROB3i's articulated arm has five axes and a gripper, all of which are powered by DC servo motors. The absolute position of all axes is determined by potentiometric rotary position transducers. The ROB3i's control system thus always knows the current position of all axes, even after a power failure.

The robot can be fitted with either an electrical or a pneumatic gripper, making it possible to perform an extremely wide range of different handling tasks. The integrated control system automatically identifies the gripper type and controls it accordingly.

The robot's integrated control system can be programmed directly via a special keypad unit, the Teachbox, using a simple, easy-to-learn instruction set. The robot is programmed by entering a sequence of instructions to move the arm to the desired positions; these instructions are then stored in memory as a control program.

Programs can be delimited or subdivided with labels, which are "address markers" inserted in the program code. This feature makes it possible to chain individual program units stored in memory. Subprograms identified by labels can also be called in response to the results of polling the status of the system's eight digital inputs, making it possible for you to program the ROB3i to respond intelligently to external events. Eight digital outputs are also included, so that you can program the ROB3i to control its working environment. But that's not all. In addition, you can choose from five different travel speeds, set delays and repeating or endless loops, and much more.

For people who enjoy working with computers, the ROB3i is also fitted with an RS-232 serial interface, making it possible to control and program the robot from any IBM-compatible personal computer. The software package available for this purpose provides the programmer with extensive support: It is menu-operated, and all the control language instructions are permanently displayed on the screen for direct selection. To add an instruction to the control program you are writing, you simply select it with the cursor keys. This approach eliminates the possibility of syntax errors. Together with the comprehensive help texts which can be displayed as needed, all these features give the system an optimally simple user interface.

For users who wish to develop their own robot control programs, software interfaces are available in the form of Include files in the languages BASIC, Pascal and C. These Include files contain subroutines for handling serial interface communication with the robot.

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2. Technical Specifications

Travel within the working range of each of the ROB3i's six axes is divided into 512 individual steps.

Axis	Relative End Position				Angular Range
1 Base rotation	right:	POS 0	left:	POS 511	200 degrees
2 Shoulder	up:	POS 0	down:	POS 511	200 degrees
3 Elbow	up:	POS 0	down:	POS 511	200 degrees
4 Wrist	up:	POS 0	down:	POS 511	200 degrees
5 Wrist roll	right:	POS 0	left:	POS 511	400 degrees
only for electric gripper					
6 Gripper	open:	POS 0	closed:	POS 100	60 mm
only for pneumatic gripper					
6 Gripper	open:	POS 0	closed:	POS 1	

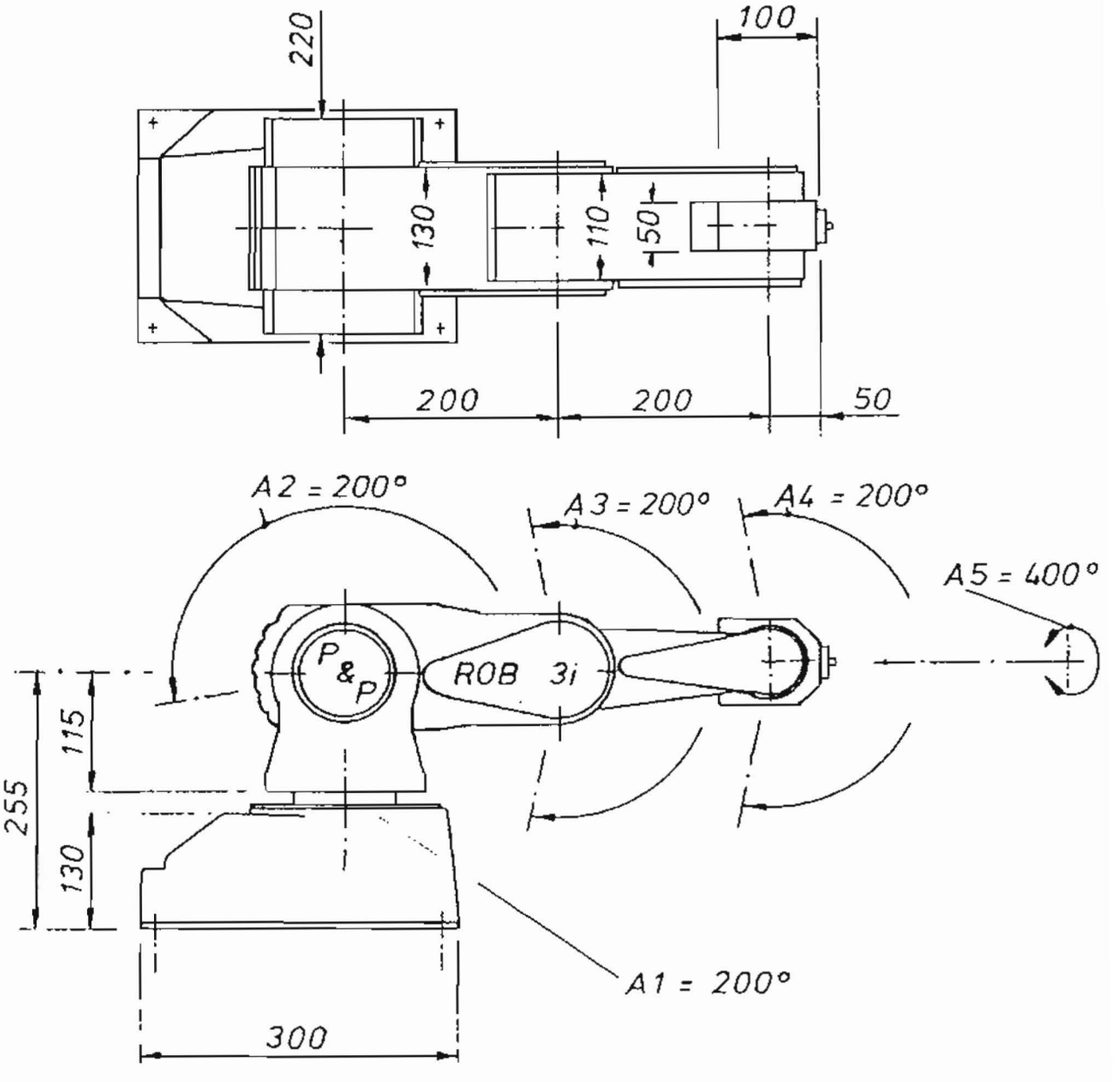
All axes can be moved simultaneously. The resolution of the axes makes it possible to access a total of 512^5 points within the robot's reach. Gripper opening and closing also has a resolution of 100 steps.

In contrast to other robots, which always have a fixed home position, the ROB3i allows you to redefine the start position at the beginning of each program. This makes it possible to use the robot in the most difficult situations imaginable, for example when the home position is obstructed by an immovable object.

Resolution, steps per axis	:	512
Repeatability	:	+/- 0.5 mm
Speeds	:	5
Maximum payload	:	500 g
Maximum traversing speed	:	750 mm per sec
Maximum continuous path speed	:	90 mm per sec
Drive	:	DC servo motors
Feedback	:	Absolute value transducers
Weight	:	13 kg
Ambient temperature	:	10 - 40 degrees C (50 - 104 F)
Interface	:	RS-232
External power supply	:	24V DC at 8A, 9V DC at 3A
8 digital outputs		
8 digital inputs		

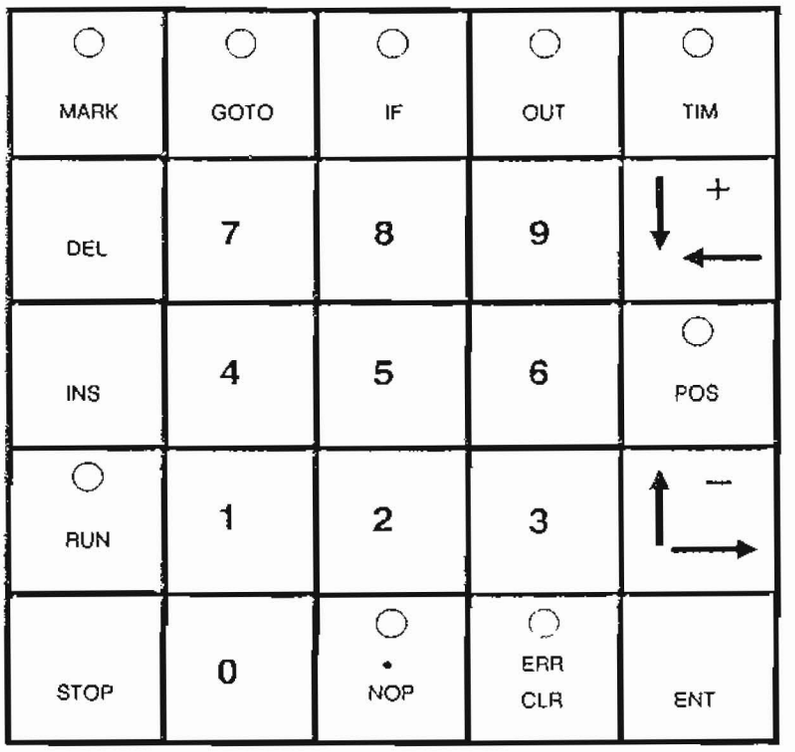
Programming options: With IBM-compatible personal computers (PC, XT, AT) and the TBPS software package; as a stand-alone unit together with the Teachbox; or with your own programs, written with the help of the Include files (controlling the robot from the computer via the RS-232 interface).

3. Dimensions and Axis Numbers



4. The ROB3i Teachbox

The ROB3i Teachbox makes it possible to operate and program the ROB3i without using a computer. It consists of a compact keypad unit with 25 keys, divided into three groups: Numeric keys for entering single or multiple-digit decimal values, command keys for entering directly-executable commands, and instruction keys for entering control program instructions. To program the robot, you simply connect the Teachbox to the ROB3i's I/O port; the unit can then be easily disconnected once the program has been started. The female connector on the Teachbox provides all the inputs and outputs necessary for interfacing with the ROB3i's I/O port. When the ROB3i is being operated with the Teachbox connected, only 3 digital outputs (DO 1-3) and 5 digital inputs (DI 1-5) are available. Each instruction key is fitted with an LED which lights up to confirm correct entry. If you make an invalid command or instruction entry, the ERR lamp will light up until you clear the incorrect entry by pressing CLR. All instructions and commands must be confirmed with the ENT key.



- Numerical Keys: Used for entering the axis designation numbers and position values.
- Command Keys:
  (RUN, STOP, INS, DEL, POS, OUT) : Commands are executed immediately.
- Instruction Keys:
  (POS, TIM, OUT, MARK, IF, GOTO, NOP) : When you enter instructions, they are stored in the robot's memory in the sequence in which you enter them. They are only executed in RUN or STEP mode.

5. Operating Modes

The robot's integrated control system has six different operating modes:

- INPUT Mode: For creating control programs by entering a sequence of instructions. This is the default mode which is activated whenever the system is powered up.

- POSITION Mode: This mode is selected by pressing one of the numerical keys 1-6, which also selects the corresponding axis. You can then move the axis forwards or backwards with the + and - keys. In this mode, you can also position the axes directly with the sequence POS (axis a) . (position n) ENT. Pressing CLR returns you to the INPUT mode.

- RUN Mode: When you enter RUN (label m) ENT, ROB3i starts executing the sequence of instructions in its memory starting at label m.

- BREAK Mode: When the robot is in RUN mode, all keys except the STOP key are disabled. Pressing STOP CLR activates the BREAK mode. You can switch back to RUN mode with RUN ENT (= CONTINUE). Pressing STOP ENT allows you to select any of the other modes.

- STEP Mode: Entering RUN . (label m) ENT switches on the STEP mode, starting at label m (provided that label m exists, of course). You can then run through the program one step at a time by pressing the + key. Pressing CLR exits the STEP mode.

- DISPLAY Mode: Entering STOP . (label m) ENT switches the system to the DISPLAY mode, starting at label m. When you press the + key, the next instruction stored in the sequence in memory is displayed (the corresponding LED on the Teachbox lights up), but the instruction is not executed on the ROB3i. Pressing CLR exits the DISPLAY mode.

6. Summary of all Instructions and Commands

Instructions:

MARK m ENT . . Set label m . . . . . m = 0..118
POS ENT . . . . . Store current position
TIM t ENT . . . . Set delay period t (x 100ms) . . . . . t = 1..65535
GOTO m ENT . . Go to label m . . . . . (endless loop)
GOTO m . n ENT . Go to label m, n times . . . . . n = 0..255
IF i ENT . . . . . Wait until input i = low
IF i . m ENT . . . . If input i = low go to label m
. . . . . else continue with next instruction
OUT k +/- ENT . . Set/clear digital output k . . . . . k = 1..8
. ENT . . . . . NOP instruction
STOP 0 ENT . . . Program start
INS . ENT . . . . . Program end
DEL . ENT . . . . Halt instruction, used to separate two consecutive programs in memory

Commands:

a +/- ENT . . . . Move axis a in POSITION mode
POS a . n ENT . . . Move axis a to position n . . . . . a = 1..6
OUT . k +/- ENT . Set/clear digital output k directly
RUN m ENT . . . Run from label m
RUN . m ENT . . . Activate STEP mode starting at label m
RUN ENT . . . . . Continue (BREAK mode)
RUN . ENT . . . . Continue (STEP mode)
STOP CLR . . . . . Break, stop program execution, continue with RUN ENT
STOP ENT . . . . . Stop, switch to INPUT mode
STOP . ENT . . . Activate DISPLAY mode
STOP .m ENT . . . Activate DISPLAY mode starting at label m
INS ENT . . . . . Insert instruction
DEL ENT . . . . . Delete instruction
CLR . . . . . Change mode, clear on error

Special features of the pneumatic gripper:

6 +/- ENT
Pressing the PLUS or MINUS key once moves the gripper to the opposite end position.

POS 6 . n ENT
An even value for n opens the gripper, an odd value closes it.

7. Reference to the Individual Instructions

- Program Start

STOP 0 ENT
This sequence generates the program header, clearing the contents of the ROB3i's memory and initializing it for programming. It should only be entered once, at the beginning of a new programming session. DON'T use this command when you want to edit programs already in memory or add new programs to the those in memory, as it will completely erase all the instructions and programs already stored in the memory!

MARK 0 ENT . . Set label 0, marks beginning of the program.

CLR . . . . . Switch to input mode.

This is followed by the body of the program, consisting of positioning sequences, loops and input and output instructions.

- Axis Positioning

(Axis a) +/-

Using this command, you can move axis a up/right or left/down with the +/- keys until it is in the desired position. Since the control program can position several axes at the same time, you can position any number of axes using this technique, until the robot arm is in the desired position.

CLR . . . . . Switch to INPUT mode.

POS ENT . . . . . Store arm position in memory

or:

POS (axis a) . (position n) ENT
Moves axis a directly to position n. Again, you can position any number of axes in this way, until the arm is in the desired position.

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store arm position in memory

- Loops

MARK m ENT . . Set label m as loop starting point

Create the body of the loop by teaching in the arm positioning sequences (see above).

GOTO m ENT . . . Loop to the starting point label (for endless loops). This option is useful

for writing endlessly repeating programs. You can terminate these programs with the STOP function.

GOTO m . n ENT . Loop to starting point label n times, thus repeating the instructions in the body of the loop n times. For i = 1 to n loop repetitions.

- I/O Instructions

IF i ENT . . . . . Stop execution at this point in the program until input i is low.

IF i . m ENT . . . If input i is low when the statement is executed, a jump is performed to label m; otherwise, execution continues with the next instruction.

OUT k +/- ENT . . Set/clear output k
Please note the negative TTL logic!
Set = low, clear = high.

OUT . k +/- CLR . Allows you to poll the I/O port and the ROB3i periphery directly, either during a programming session or during a break in program execution. Please don't terminate this command with ENT, as this will store it in memory as part of the control program.

- Set Delay

TIM t ENT

Allows you to interrupt program execution for a specified period (t x 100 ms). The range of t is from 0 to 65535, which means that you can program delays of up to 100 minutes. Insert the instruction in a loop to program longer delays.

- Program Halt

DEL . ENT

Generates a program halt, and switches on the RUN lamp. Execution can be restarted by pressing ENT. This instruction is also used as a separator between consecutive, separate programs in memory. Pressing CLR switches to INPUT mode.

- Program End

INS . ENT

This sequence must always be entered at the end of every teach-in program. When you are editing existing programs, it should never be entered if you make changes in the body of the program only, but you MUST enter it if you lengthen the program by overwriting the original program end instruction (see Appending Instructions below).

- DISPLAY Mode

STOP . m ENT / STOP . ENT

These commands switch the system to DISPLAY mode, allowing you to display the program instructions stored in memory one after another via the LEDs, by pressing the + and - keys to step forwards and backwards through the program. The MARK, POS, TIM, OUT, IF and NOP instructions are displayed directly with the LEDs of the corresponding keys; the DEL . instruction is displayed with the MARK and NOP LEDs together. The ERR LED lights up in the event of errors and at the end of the program (program end instruction). Pressing the CLR key exits the DISPLAY mode.

- Insert Instruction

INS ENT

The DISPLAY mode makes it simple to move to the position where you want to insert one or more additional instructions. To insert instructions, proceed as follows: First, switch to DISPLAY mode and locate the instruction BEFORE which you want to insert the new instruction(s). Press CLR to exit the DISPLAY mode, and then press INS ENT once for each instruction you wish to insert. This inserts NOPs, which you can later overwrite with the appropriate instructions.

- Delete Instruction

DEL ENT

In the same way as for inserting instructions, first switch to DISPLAY mode and locate the position at you wish to begin deleting, then press CLR to exit DISPLAY. Now press DEL ENT once for each instruction to be deleted. Each time you press DEL ENT, the current instruction is cleared from memory and all the following instructions are moved up by one line, allowing you to go on deleting towards the end of the program.

- Appending Instructions

Existing programs can be lengthened very easily by overwriting the program end instruction. First, switch to DISPLAY mode and locate the end of the program. The ERR LED will light up. Now press CLR to switch to INPUT mode, and simply enter the additional instructions normally. Don't forget to enter the INS . ENT sequence again when you are finished!

- Overwriting Instructions

This function is used to overwrite previously-entered NOPs, existing instructions or NOPs entered directly with the INS ENT sequence. Switch to DISPLAY mode and locate the instruction you wish to overwrite, then press the CLR key and enter the new instructions directly.

- Program Run / Break

You can choose between running the program normally or in single-step mode.

RUN m ENT . . . . Start normal program execution at label m

STOP CLR . . . . . Break program execution at any point

RUN ENT . . . . . Resume program execution at point where it was interrupted

The instruction sequence RUN . m ENT selects single-step mode, allowing you to test the program by running it one instruction at a time. You can then step through the program with the + key. Each time you press +, the next instruction in the memory is executed, moving the robot axes and lighting up the corresponding LED on the Teachbox.

8.Hardware Installation

The robot can be fitted with either an electrical or a pneumatic gripper, making it possible to perform an extremely wide range of different handling tasks. The integrated control system automatically identifies the gripper type and controls it accordingly.

Installing the electrical gripper is a simple mechanical operation. Proceed as follows:

- Snap the electrical gripper onto the gripper mounting flange in the position you wish to define as the center position.
- Insert the gripper plug into the matching socket and screw it into place. Arrange the spiral cable so that it will not obstruct the gripper.
- The ROB 3i is then ready for operation with the electrical gripper.

To install the pneumatic gripper, proceed as follows:

- Snap the pneumatic gripper onto the gripper mounting flange in the position you wish to define as the center position.
- Coil the black and blue hoses loosely around the gripper's rotary axis, then connect them to the gripper. Connect the blue hose to the connection which is closest to the gripper fingers.
- Insert the plug attached to the red and black cable into the matching socket and screw it into place.
- Mount the pressure reducing valve on the base of the robot, using two screws. Connect the blue compressed air hose from the base of the robot to the pressure reducing valve.
- Snap the FESTO PU3 compressed air hose onto the FESTO CN-M5-PK3 connector nipple (max. operating pressure 6 bar / 6000 hPa). The pressure reducing valve is set for a gripper operating pressure of 5 bar / 5000 hPa.
- The ROB 3i is then ready for operation with the pneumatic gripper.

Hardware requirements:

- The ROB3i
- The power supply unit
- The Teachbox
- The RS-232 shorting connector

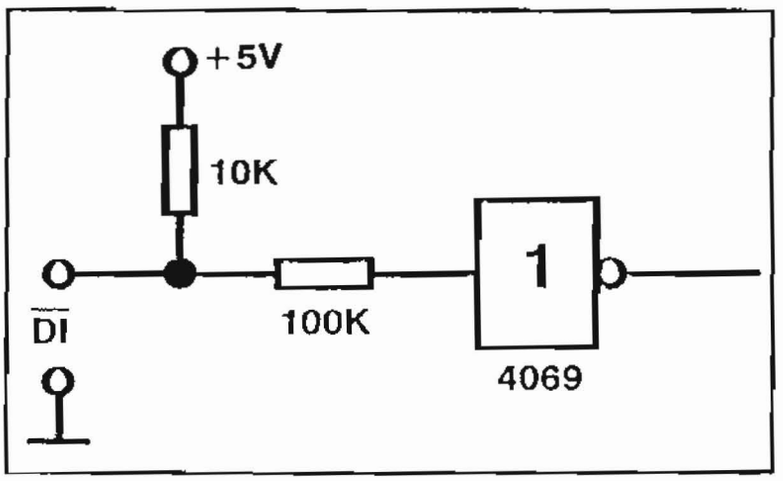
Connect the ROB3i to the power supply unit with the two power leads. Plug the Teachbox's 25-pin male connector into the I/O port and the 9-pin shorting connector into the RS-232 port. Turn the power switch to ON, and press the RESET key on the ROB3i. Now you can enter a program or move the ROB3i's arm directly with the appropriate instructions.

The ROB3i's program memory is nonvolatile, and is powered by a long-life lithium battery; your programs will remain stored in the robot's memory for around 10 years, even when the mains power is switched off.

9. Digital Inputs and Outputs, EMERGENCY OFF Function

- Digital Inputs (TTL)

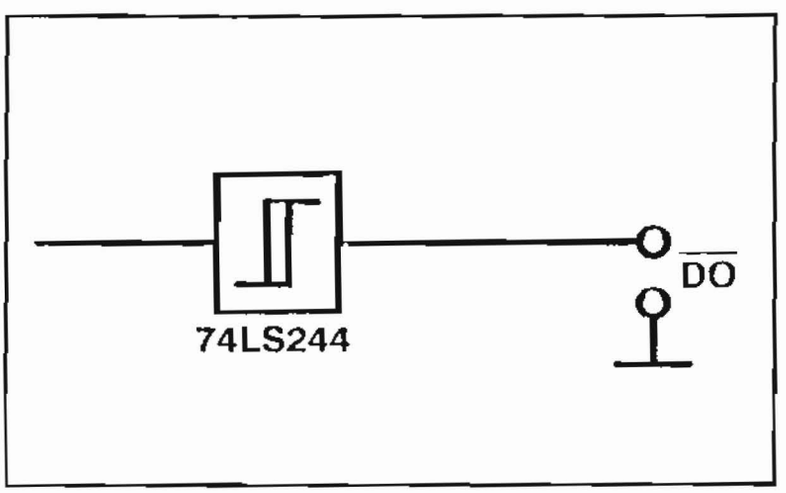
DI1: Pin 8
DI2: Pin 20
DI3: Pin 7
DI4: Pin 19
DI5: Pin 6
DI6: Pin 18
DI7: Pin 5
DI8: Pin 17



All the digital inputs are active LOW

- Digital Outputs (TTL)

DO1: Pin 25
DO2: Pin 12
DO3: Pin 24
DO4: Pin 11
DO5: Pin 23
DO6: Pin 10
DO7: Pin 22
DO8: Pin 9



All the digital outputs are active LOW

- EMERGENCY OFF for the ROB3i

DI10: Pin 4

The EMERGENCY OFF input is active LOW

The emergency off function is realized with an NOC across pins 4 and 1 of the robot's I/O port. Activation of the function switches off the ROB3i's motors. After eliminating the problem, you must execute a RESET on the ROB3i unit, then you can restart the control program.

- Power Supply

Gnd : Pin 1

+ 5V Pins 2/13 I < = 50mA

The power supply unit is only suitable for the connection of optocouplers. Any external driver stages must be provided with their own power supply. Please note that the ground lines should NOT be connected when optocouplers are being used.

10. Exercises with the Teachbox

Connect the ROB3i and switch it on as described in Section 8, Hardware Installation. Before you begin the exercises, we suggest that you first move the robot's arm to the following home position:

Axis	Position
1	255
2	255
3	255
4	255
5	255
6	0 (electric or pneumatic gripper is open)

To position the first axis, enter the following key sequence: POS 1 (decimal point). ENT. When you press ENT, axis 1 of the ROB3i will immediately move into position 255, which is the central position. Repeat the procedure with the appropriate values for the remaining five axes.

CAUTION:

Please be extremely careful when you position axes 2 and 3 directly, as these axes can move the gripper below the plane of the surface on which the ROB3i is mounted, which can result in gripper damage. Positions 0..30 and 225..255 with axis 2 are particularly dangerous. If the gripper ever does collide the tabletop when you are positioning the arm directly, press the STOP key on the Teachbox immediately and hold it down until you have pressed the RESET key on the ROB3i. This initializes the last arm position as the current position. The ROB3i will then stop in this position, and you can change the position by entering further teach instructions. Please note that a reset clears all program instructions entered beforehand from the robot's memory, and they must then be reentered from the start.

If the red ERR lamp on the Teachbox lights up while you are entering instructions, first clear the error condition by pressing the CLR key, then reenter the last instruction sequence.

All the following exercises are entered with label 0 as the starting address, and can be started by entering RUN 0 ENT. If you wish, however, you can also enter other starting addresses, so long as they are within the permitted value range (0 < = starting address < = 118).

- Program Header and Program End

STOP 0 ENT
This sequence generates the program header, clearing the contents of the ROB3i's memory and initializing it for programming. It should only be entered once, at the beginning of a new programming session. DON'T use this command when you want to edit programs already in memory or add new programs to the those in memory, as it will completely erase all the instructions and programs already stored in the robot's memory!

MARK 0 ENT . . Set label 0 as the starting address, marking the beginning of your program.

CLR . . . . . Switch to POSITION mode

This is followed by the body of the program, consisting of positioning sequences, loops and input and output instructions.

INS . ENT
This sequence must always be entered at the end of every taught-in program. When you are editing existing programs, it should never be entered if you make changes in the body of the program only, but you MUST enter it if you lengthen the program by overwriting the original program end instruction and adding more instructions.

- Practice Programs

PROGRAM 1: Single Axis Positioning

STOP 0 ENT . . . . Clear memory, generate program header

MARK 0 ENT . . . Enter start address

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store home arm position as starting position

(All the practice programs begin with these four lines)

1 . . . . . Select axis 1 for TEACH positioning

+ . . . . . Depress key to turn right in TEACH mode

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as position 2

1 . . . . . Select axis 1 for TEACH positioning

- . . . . . Depress key to turn left in TEACH mode

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as position 3

POS 1 . 400 ENT . . Move axis 1 to position 150

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as position 4

POS 1 . 50 ENT . . Move axis 1 to position 50

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as position 5

INS . ENT . . . . . Program end

This program uses two different methods for entering single axis movements: Direct teaching, using the + and - keys, and direct entry of the target position with the POS (axis a) . (position n) ENT instruction sequence. Both of these methods can be used for all the robot's axes.

PROGRAM 2: Consecutive Single Axis Positioning for all 6 Axes

STOP 0 ENT . . . . Clear memory, generate program header

MARK 0 ENT . . . Enter start address

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store home arm position as starting position

(Standard beginning of the program)

POS 1 . 400 ENT . . Move axis 1 to position 150

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as position 2

2 . . . . . Select axis 2 for TEACH positioning

- . . . . . Depress key to move up in TEACH mode

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as position 3

POS 3 . 180 ENT . . Move axis 3 to position 50

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as position 4

4 . . . . . Select axis 4 for TEACH positioning

- . . . . . Depress key to move up in TEACH mode

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as position 5

POS 5 . 10 ENT . . Move axis 5 to position 10

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as position 6

6 . . . . . Select axis 6 for TEACH positioning

- . . . . . Press key to open gripper in TEACH mode

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as position 7

INS . ENT . . . . . Program end

In the above example, all of the robot's axes are moved one after another in a consecutive sequence. When you start the program, all the axes will first be moved simultaneously to bring them back into the original home position, and then the programmed movement sequence will be repeated.

PROGRAM 3: Simultaneous Multiple Axis Positioning

Note: No matter how many axes you move, the new robot arm position is not stored in the memory until you enter the POS ENT sequence.

STOP 0 ENT . . . . Clear memory, generate program header

MARK 0 ENT . . . Enter start address

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store home arm position as starting position

(Standard beginning of the program)

POS 1 . 400 ENT . . Move axis 1 to position 150

2 . . . . . Select axis 2 for TEACH positioning

- . . . . . Press key to move up in teach mode

CLR . . . . . Switch to INPUT mode

POS 3 . 180 ENT . . Move axis 3 to position 50

4 . . . . . Select axis 4 for TEACH positioning

- . . . . . Press key to move up in TEACH mode

5 . . . . . Select axis 5 for TEACH positioning

- . . . . . Press key to turn right in TEACH mode

6 . . . . . Select axis 6 for TEACH positioning

- . . . . . Press key to open gripper in TEACH mode

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as target position

INS . ENT . . . . . Program end

Now that you have familiarized yourself with beginning and terminating programs and positioning single and multiple axes, you can start adding other instructions to your programs. Please consult Sections 6 (Summary of all Instructions and Commands) and 7 (Reference to the Individual Instructions) for full details.

PROGRAM 4: Sample Program

STOP 0 ENT . . . . Clear memory, generate program header

MARK 0 ENT . . . Enter start address

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store home arm position as starting position

(Standard beginning of the program)

TIM 40 ENT . . . . Set delay, 4 seconds

POS 1 . 400 ENT . . move axis 1 to position 150

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as position 2

IF 1 ENT . . . . . Wait until input 1 is set (LOW = gnd)

2 . . . . . Select axis 2 for TEACH positioning

- . . . . . Press key to move up in TEACH mode

CLR . . . . . Switch to INPUT mode

POS 3 . 180 ENT . . Move axis 3 to position 50

4 . . . . . Select axis 4 for TEACH positioning

- . . . . . Press key to move up in TEACH mode

CLR . . . . . Switch to INPUT mode

POS ENT . . . . . Store new position as position 3

TIM 20 ENT . . . . Set delay, 2 seconds

(The following sequence switches another machine or device on, leaves it on for 10 seconds then switches it off again.)

OUT 1 + ENT . . Set output 1 to LOW = gnd

TIM 100 ENT . . . Set delay, 10 seconds

OUT 1 - ENT . . . Reset output 1 to HIGH = +5V

GOTO 0 . 5 ENT . Loop to label 0 5 times

INS . ENT . . . . . Program end

Tips and Suggestions:

- You should also set a delay of 1/2 second before gripping or releasing something with the gripper. This gives the gripper time to come to rest, ensuring that the object will be gripped and released smoothly and cleanly.
- We strongly advise that you first test your programs in single-step mode after teaching them in. Start the program with RUN . 0 ENT; you can then step through the program one instruction at a time with the + key. All the instructions (MARK, POS, TIM etc.) will be displayed on the LEDs of the Teachbox as they are executed, starting with the first MARK instruction and ending with the program end instruction (the latter is indicated by the ERR LED). At the same time, the robot will execute the programmed movements.

11. Limited Warranty Terms and Conditions

Warranted against defects in materials and workmanship for a period of 6 (six) months as of the date of purchase, delivery free works. Wearing parts such as motors and potentiometers are excluded from this Warranty coverage. The use of physical force, incorrect connection and any and all alterations or repair attempts on the part of the Customer will render this Warranty null and void.

We reserve the right to make technical alterations without notice.

Shipping address for service and repair:

P + P Elektronik GmbH
Nordring 23, 8510 Fürth 2, West Germany, Tel. 0911 - 3000-611, FAX 0911 - 3000-622

12. Foreign Distributors

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